

REMARKS

In the Office Action dated November 2, 2004, claims 1 and 19 were objected to; the Abstract was objected to; claims 1-7, 10, and 11 were rejected under 35 U.S.C. § 102 over U.S. Patent Application Publication No. 2002/0089874 (Nickel); claims 1, 8, 9, 19-21, 23, and 24 were rejected under § 103 over U.S. Patent No. 6,542,402 (Hidaka) in view of U.S. Patent No. 6,385,082 (Abraham); and claims 12 and 22 were rejected under § 103 over Hidaka in view of Abraham and U.S. Patent Application Publication No. 2003/0235072 (Kim).

RESTRICTION REQUIREMENT

Applicant confirms the election of the invention of Group I, which includes claims 1-12 and 19-24, as well as newly added claims 25-33. Claims 13-18 have been cancelled without prejudice to filing such claims in a divisional application.

CLAIM OBJECTIONS

Claims 1 and 19 have been amended to address the objections to the claims.

OBJECTION TO THE ABSTRACT

The Abstract has been amended to address the objection to the Abstract.

REJECTIONS UNDER 35 U.S.C. §§ 102 AND 103

Amended claim 1 recites a memory device having an array of magnetic storage cells, each cell including a first magnetic layer, a second magnetic layer, and a dielectric in between the first and second magnetic layers. The memory device also includes a first set of conductors to receive current for writing data to the magnetic storage cells, and a second set of conductors to provide a voltage across the second set of conductors to cause current flow through at least one of the magnetic storage cells for heating the at least one magnetic storage cell when writing a bit of data to the at least one magnetic storage cell.

Amended claim 1 is not disclosed by Nickel. Nickel describes a conductor 22 (see Fig. 1 of Nickel) which makes up a heating line. The heating line is described further with respect to Fig. 4, with Nickel stating that the heating line includes copper traces separated by heating elements made of tungsten or platinum or other highly resistive metal. Nickel, ¶ [0033]. Nickel does not disclose a set of conductors to provide a voltage across the set of conductors to cause

current flow through the magnetic storage cell for heating the magnetic storage cell. In fact, the Office Action has conceded this point, since the Office Action did not reject claim 19 over Nickel. Claim 19 recites an electronic device having a memory device that includes a second set of conductors for applying a voltage across a magnetic storage cell for heating the magnetic storage cell.

In view of the foregoing, it is respectfully submitted that claim 1 is not anticipated by Nickel.

Claim 1 was also rejected as being obvious over Hidaka and Abraham. Specifically, the Office Action pointed to Fig. 20 (along with Fig. 42) of Hidaka as teaching some of the elements of claim 1. Fig. 20 of Hidaka shows a memory cell having a magnetic tunnel junction (MTJ) and a write word line (WWL), a write bit line (WBL), a read word line (RWL), and a read bit line (RBL). The electrical schematic diagram for the memory cell of Fig. 20 of Hidaka is shown in Fig. 18 of Hidaka, and the data write and data read operations for this memory cell are depicted in Fig. 19.

The Office Action identified WWL and WBL as being the first set of conductors, and RBL and barrier metal 140 as being the second set of conductors. As conceded by the Office Action, Hidaka does not disclose that the RBL and barrier metal 140 provide a voltage to cause current to flow through a magnetic storage cell for heating the magnetic storage cell when writing a bit of data to the magnetic storage cell. 11/02/2004 Office Action at 6. However, the Office Action relied upon Abraham as teaching the application of a voltage across a magnetic storage cell for heating the magnetic storage cell. The Office Action pointed specifically to the structure in Fig. 5 of Abraham, which shows a voltage source 54 applying a voltage across a word line 2 and a bit line 5 that sandwiches a magnetic tunnel junction.

It is respectfully submitted that no motivation or suggestion existed to combine the teachings of Abraham and Hidaka to achieve the claimed invention. Abraham teaches the presence of just one word line conductor and one bit line conductor for each memory cell for performing both write and read operations. Hidaka, on the other hand, teaches four conductors, a write word line conductor, a read word line conductor, a write bit line conductor, and a read bit line conductor, for each memory cell. Hidaka also discloses that metal wiring made up of structures 140, 150, and an M1 conductor, is provided underneath the magnetic tunnel junction

(see Fig. 20 of Hidaka). The metal wiring made up of conductors 140, 150, and M1 is floating during a write operation (see Figs. 18 and 19) when the read word line RWL is at a low potential to turn off the transistor ATR. Consequently, the metal wiring made up of the conductors 140, 150, and M1 would be pulled to the voltage of RBL during a write operation. In other words, a person of ordinary skill in the art would have been taught that there can be no voltage developed across the RBL and the metal wiring (140, 150, M1) during a write operation. What this effectively means is that there can be no current flow through the magnetic tunnel junction in the Hidaka magnetic storage cell during a write operation. In fact, a person of ordinary skill in the art would not have been motivated to create a voltage potential across the magnetic tunnel junction of Hidaka, as providing such a voltage across the magnetic tunnel junction of Hidaka would have rendered the storage cell of Hidaka inoperable for its intended operations (for performing writes and reads).

In view of the foregoing, it is respectfully submitted that no motivation or suggestion existed to combine the teachings of Hidaka and Abraham to achieve the claimed invention. A *prima facie* case of obviousness cannot be established against claim 1.

Amended independent claims 19 and 23 are similarly allowable over the asserted combination of Hidaka and Abraham.

Claim 12 has been amended from dependent form to independent form. Claim 12 recites that the magnetic memory device includes a heater element placed in series with the at least one magnetic storage cell.

The Office Action conceded that Hidaka and Abraham fail to disclose this additional feature of claim 12. 11/02/2004 Office Action at 7. However, the Office Action relied upon Kim as disclosing the missing element.

Applicant respectfully submits that no motivation or suggestion existed to combine the teachings of Hidaka, Abraham, and Kim. Although both Hidaka and Abraham teach the use of a magnetic tunnel junction that employs the use of orthogonal current flows in two different conductors to cause a write of a free magnetic layer of the magnetic tunnel junction, Kim teaches a different type of memory cell. In Kim, only one magnetic layer is provided, not two magnetic layers separated by a dielectric. The one magnetic layer in the storage cell of Kim is layer 52 (see Fig. 1), which is separated by an insulator 54 from a write line 56 (a conductor). To write a

logical "1" to the memory layer 52, a current value is applied to the write line 56, and a heating means 50 is activated. Kim, ¶¶ [0039], [0042]. However, if a logical "0" is to be written to the memory layer 52, then *no* current is applied to the write line 56 such that *no* magnetic field is formed around the write line. The paramagnetic state of the memory layer 52 in Kim is obtained from heating alone. Kim, ¶ [0043].


The use of the heating means 50 in Kim is thus used to compensate for the fact that only one conductor (write line 56) is present for writing to the memory cell of Kim. This situation clearly is not present in either of the storage cells of Hidaka or Abraham, where multiple conductors are provided to route orthogonal current flows to cause magnetic fields to be generated for orienting the free magnetic layer of the magnetic tunnel junction. In view of the foregoing, it is respectfully submitted that no motivation or suggestion existed to combine the teachings of Hidaka, Abraham, and Kim. A *prima facie* case of obviousness has thus not been established with respect to the invention of claim 12.

Dependent claims, including newly added dependent claims 25-33, are allowable for at least the same reasons as corresponding independent claims.

Allowance of all claims is respectfully requested. The Commissioner is authorized to charge any additional fees and/or credit any overpayment to Deposit Account No. 08-2025 (200205288-1).

Respectfully submitted,

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